October 29, 1997 OSD:PMT

MEMORANDUM FOR: James Silva
OSD/METOP Ground System Team Leader

FROM: Pamela Taylor
OSD/Polar Product Manager
Interim METOP Ground System Team Leader

SUBJECT: Consolidation of NOAA:s Comments of the IJPS PIP Vers. 13

Attached is a proposed new version of the Initial Joint Polar-orbiting System (IJPS) Program Implemenation Plan (PIP). This version contains all of the specific comments provided by the NOAA METOP Ground System Team during the formal PIP review held Oct 8-9, 1997. In addition I have attached a list of general PIP comments submitted by the team.

This version of the PIP is submitted for both internal NESDIS office director review/concurrence and for provision to EUMETSAT Ground System personnel.

Distribution: OSD - M.Mignogno
All METOP Ground System Team Members and Alternates

PROGRAM IMPLEMENTATION PLAN
(PIP)

FOR
COOPERATION BETWEEN NOAA AND EUMETSAT

DRAFT 13

(NOAA COMMENTS)
10.29.97

[NM] = **N**OAA **M**odified section

BOLD TEXT = Text modified by NOAA

1 INTRODUCTION

1.1 Purpose and Scope

[NM] 1.1.1 Purpose

This document constitutes the Program Implementation Plan **(PIP)** called upon by the Agreement between the United States **(U.S.)** National Oceanic and Atmospheric Administration (NOAA) and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) on a **Initial Joint Polar-orbiting System** (IJPS).

This plan covers the system associated with the NOAA-N, NOAA-N**:**, METOP-1 and METOP-2 **(METeorological OPerational)** satellites. **In the event that NOAA-M is the NOAA operational afternoon satellite at the time of METOP-1 operations, this plan also extends to the NOAA-KLM series. Therefore all references to NOAA-N in this plan also apply to NOAA-M.**

This plan does not address the U.S. DoD Defense Meteorological Satellite Program (DMSP), the future U.S. National Polar-orbiting Operational Satellite System (NPOESS), or the future METOP-3 and METOP-4 satellites.

Throughout this document the term *spacecraft* refers to the space vehicle (bus) upon which the instruments will embark. The term *payload* refers to the instrument set. The term *satellite* refers to the spacecraft and its payload.

1.1.2 Document Structure

This PIP contains:

- in Chapter 2, the technical description of the IJPS and its operational requirements;
- in Chapter 3, a recall of the main responsibilities of each party
- in Chapters 4, 5, and 6 the deliverables and services provided by each Party;
- in Chapter 7, the Program Management Scheme;

[NM] 1.1.3 Associated **Documentation**

[NM] 1.1.3.1 Upper Level Document

This PIP responds to the AAgreement between the United States National Oceanic and Atmospheric Administration and the European Organisation for the Exploitation of

Meteorological Satellites on an **Initial Joint Polar-orbiting System@** called hereafter the Agreement.

In case of conflict between this PIP and the Agreement, the Agreement shall take precedence. Issues requiring interpretation/resolution will be brought to the attention of the Programme Managers.

[NM] 1.1.3.2 Documentation

A set of documents is identified which specifies the technical interfaces between the elements of the IJPS developed by the two Parties. They are listed in **Annex 1** and are referenced in this **PIP** under the acronym JBD (Joint Baseline Documents). These documents will be subject to configuration control as per section 7.8 of this **PIP**.

A further set of documents is identified which specifies the performances and/or characteristics of the various elements of the IJPS. They are listed in **Annex 2** and are referenced in this PIP under the acronym RD (Reference Document). These documents will be subject to an exchange of information- as per section 7.8 of this **PIP**.

[NM] 1.2 Background

Meteorological satellite data from polar orbit have been freely provided by the U.S. to the rest of the world for more than thirty years, and on a fully operational basis for more than two decades. The existing service is provided by NOAA, using data from two operational satellites in sun-synchronous, polar orbits: one in a **morning** orbit (at **a nominal** altitude of 833 km, with a descending equatorial crossing-time of approximately 07:30) and the other in an afternoon orbit (at **a nominal** altitude of 870 km, with an ascending equatorial crossing-time of approximately 13:30). NOAA is committed to continue to provide data coverage from both orbits through the year 2000, after which time EUMETSAT plans to assume responsibility for a **morning** orbit service. NOAA will continue to be responsible for the **afternoon** orbit service. This will result in a joint polar system, the responsibility and costs of which will be more equitably divided between Europe and the United States.

1.3 IJPS Mission Objectives

[NM] 1.3.1 General

The general objective of the IJPS is to collect **and exchange** global environmental data to support operational meteorological and environmental forecasting and global climate monitoring. The core IJPS missions and services are outlined below, the primary ones being the global sounding and imagery missions.

[NM] 1.3.2 Missions

Global Sounding

The global sounding mission provides vertical profiles of temperature and humidity to support numerical forecasting models.

Global Imagery

The global imagery mission provides cloud imagery for forecasting applications, sea surface temperatures, vegetation index monitoring, snow cover, sea ice extent, aerosols and radiation budget parameters. It also supports the global sounding mission through the identification of cloud free areas.

Space Monitoring

The space monitoring mission provides information on the solar terrestrial environment to include solar flux, energetic particle density, and magnetic field parameters.

Wind Scatterometry

The wind scatterometry mission provides speed and direction of winds at the ocean surface.

Climate Monitoring

The climate monitoring mission provides, inter alia, information from imagery and sounding, sea ice coverage information, ozone observations.

[NM] 1.3.3 Data Access

Global Data Access

In order for each party to meet timeliness requirements of their meteorological forecast services, the raw global data is made available to each party within 2 h 15' of the instant of observation.

[Further discussion required. Current Transmission scheme presented by EUMETSAT with a 4 MBS link does not meet this requirement for NOAA to receive the METOP Orbital data (70 GBytes/Orbit). Orbit + Transmission = 102 + 76 minutes = 178 minutes which exceeds the 135 minute requirement. Options which include either increasing the link to 8-10 MBS or placement of a front end processor (FEP) at***

the EUM PCDA to do either 1)data compression 2) data prioritization or 3) data selection/removal or a combination of these functions, need to be investigated]

Local Data Access

Data are broadcast in real-time for reception by local receiving stations, during a satellite overpass, for the support of analysis and forecasting activities.

[NM] 1.3.4 Services

Data Collection and Location

The data collection and location service supports the activities of the World Weather Watch (WWW) of the World Meteorological Organisation (WMO) by receiving and disseminating in situ observations from ocean buoys and other similar data collection platforms.

Search and Rescue

The search and rescue service supports the provision of the location of emergency beacons to rescue forces worldwide.

[NM] 1.4 Framework for the **Initial Joint Polar-orbiting System**

[NM] 1.4.1 General

The **Initial Joint Polar-orbiting System** will be a joint European / U.S. endeavor, with EUMETSAT assuming responsibility for the **mid-morning** orbit and NOAA being responsible for the **afternoon** orbit. To maintain compatibility, the operational meteorological payload will, as far as possible, be common to both the **mid-morning** and **afternoon satellites**. Furthermore, the respective EUMETSAT and NOAA Ground Segments will, as far as possible, be compatible regarding data exchange and processing.

[NM] 1.4.2 Instruments provided by NOAA

The common payload instruments to be provided by NOAA for the NOAA and EUMETSAT **satellites** consists of the:

1) Advanced Very High Resolution Radiometer (AVHRR);
2) High-Resolution Infrared Sounder (HIRS);
3) Advanced Microwave Sounding Unit (AMSU-A);
4) Space Environment Monitor (SEM);
5) Satellite-Aided Search and Rescue instrument (SARSAT).

The additional payload instrument to be provided by NOAA for the NOAA **satellite** is the Solar Backscatter Ultra Violet **instrument** (SBUV).

[NM] 1.4.3 Instruments provided by EUMETSAT

The common payload instrument to be provided by EUMETSAT for the NOAA and EUMETSAT spacecraft is the Microwave Humidity Sounder (MHS).

The additional payload instruments to be provided by EUMETSAT for flight on the EUMETSAT spacecraft consist of the:

1) Infrared Atmospheric Sounding Interferometer (IASI);
2) Advanced Scatterometer (ASCAT);
3) **Global** Ozone Monitoring Instrument (**G**OMI);
4) Global navigation satellite system Receiver for Atmospheric Sounding (GRAS).

1.4.4 Instrument provided by NOAA and EUMETSAT

The Data Collection and Location System (ARGOS), which is a common payload instrument, is provided by NOAA for NOAA-N and NOAA-N' and provided by EUMETSAT for METOP-1 and METOP-2.

[NM] 1.4.5 Development Framework

EUMETSAT is working together with the European Space Agency (ESA) to develop a **METOP** series of spacecraft, which will comprise the Space Segment of the EUMETSAT Polar System **(EPS)**. METOP is designed to be an operational meteorological spacecraft accommodating the **instruments referenced in sections 1.4.2 through 1.4.4 above**. **The additional** instruments, ASCAT, **GOMI**, and GRAS **will** be provided as part of **a** METOP undertaking. The atmospheric sounding capability will be upgraded by the introduction of an advanced infrared sounder, the Infrared Atmospheric Sounding Interferometer (IASI), being developed jointly by CNES and EUMETSAT. The first spacecraft of this series, METOP-1, is scheduled for launch in *mid-**2002? [please confirm date]***, with the second, METOP-2, planned to be launched in line with operational needs.

NOAA is currently producing its latest generation of spacecraft, NOAA-K-L-M, N and N **NOAA-N** is planned to be launched in approximately the same **time frame** as METOP-1.

[NM] 1.4.6 Development Time Frame

[include a Ageneral@ project plan/schedule]

[NM] 2 TECHNICAL AND OPERATIONAL REQUIREMENTS OF THE **INITIAL JOINT POLAR-ORBITING SYSTEM**

[NM] 2.1 General

To fulfill the objectives of the cooperation laid down in the Agreement, the IJPS consists of the following elements:

- a Space Segment composed of:

  . **the current NOAA afternoon satellite at the time of METOP-1 operations to include** a series of 2 spacecraft flown consecutively in an orbit with an afternoon equatorial crossing time (ascending node), **and** NOAA-N and NOAA- N';

  . a series of 2 **satellites** flown consecutively in an orbit with a **mid-**morning equatorial crossing time (descending node), METOP-1 and METOP-2;

  . a set of common instruments to be flown on both the **mid-**morning and the afternoon **satellites**,

  . a set of additional instruments specific for each orbit.

- a NOAA and a EUMETSAT Ground Segment **each comprising**;

  . at least one Satellite Control Center and a geographically separate back up **for their respective satellites as defined by RDx [to be defined off-line];**

  . at least one Command and Data Acquisition ground station and a (geographically separate) back up;

  . at least one Data Processing, Distribution and Archive Facility;

  . telecommunications capabilities between NOAA and EUMETSAT necessary to ensure the timely and reliable exchange of telemetry and data as defined further in section 2.6.

[Throughout this document the term *spacecraft* refers to the space vehicle (bus) upon which the instruments will embark. The term *payload* refers to the instrument set. The term *satellite* refers to the spacecraft and its payload.] {this section moved to 1.1.1}

Each spacecraft shall provide for:

- the recording and the read-out of all science data generated by the common instruments and additional payloads and of the auxiliary data needed to process this data.

- the direct broadcast to worldwide local users of the science data generated by the IJPS instruments at high resolution (High Resolution Picture Transmission) and at low resolution (Automatic Picture Transmission, APT or Low Resolution Picture Transmission, LRPT);

- housekeeping telemetry and telecommand capabilities.

2.2 Instrumentation

[NM] 2.2.1 IJPS **C**ommon **I**nstrumentation

The instrument set to be carried on both the **mid-**morning and the afternoon spacecraft shall **consist** of:

INSTRUMENT	INSTRUMENT TYPE
AVHRR/3 Advanced Very High Resolution Radiometer	Imaging radiometer, with six channels in the range 0.6-12 microns
HIRS/4 High-resolution Infra-Red Sounder	Sounder with 19 infrared channels in range 3-15 microns, and one visible channel.
AMSU-A 1/2 Advanced Microwave Sounding Unit-A	Microwave sounder with 15 channels in the range 23-90 **GHz.**
MHS Microwave Humidity Sounder	Microwave sounder with five channels at 89, 157 and around 183 GHz
ARGOS (DCS) Data Collection System	UHF receiver and signal processor.
S&R / SARP **(SARSAT)** Search & Rescue Processor	UHF receiver and signal processor.
S&R / SARP **(SARSAT)** Search & Rescue Repeater	VHF / UHF / L-Band Transponder
SEM Space Environment Monitor	Multichannel charged-particle spectrometer

The AVHRR/3 performance specifications are defined in [RD1].

The HIRS/4 performance specifications are defined in [RD2].

The AMSU-A 1/2 performance specifications are defined in [RD3].

The MHS performance specifications are defined in [RD4].

The **ARGOS** performance specifications are defined in [RD5].

The S&R performance specifications are defined in [RD 6].

The SEM performance specifications are defined in [RD 8].

2.2.2 **Mid-Morning** Spacecraft Additional Payload

The **mid-morning** spacecraft shall embark the following additional instruments:

INSTRUMENT	INSTRUMENT TYPE
IASI Infrared Atmospheric Sounding covering the 3.4-15.5 **micron** range. Interferometer	Infrared Michelson Interferometer
ASCAT Advanced Scatterometer	Pulsed C-band radar
GRAS Global navigation satellite system Receiver for Atmospheric Sounding	Radio Occultation Receiver
GOMI **Global** Ozone Monitoring Instrument	Nadir-viewing Spectrometer

The IASI requirements are defined in [RD9].

The ASCAT requirements are defined in [RD10].

The GRAS requirements are defined in [RD 11].

The **GOMI** requirements are defined in [RD 13].

2.2.3 Afternoon Spacecraft Additional Payload

The afternoon spacecraft shall embark the following additional instruments:

Instrument	Instrument Type
SBUV/2 Solar Backscatter Ultra Violet Spectral Radiometer	Spectral Radiometer with 12 channels in the range 252.0.322.3 NM (discrete mode) and 160-400 NM (scan mode).

The SBUV requirements are defined in [RD 14].

[NM] 2.3 Orbital Characteristics

The IJPS shall exhibit the following orbital characteristics:

PARAMETER	MORNING S/C	AFTERNOON S/C
Mean Solar Local Time at Equatorial Crossing Tolerance	Descending Node: 9h 30 **+/- 5 minutes**	Ascending Node: 14 h 00 **+/- 30 min from launch (uncontrolled)**
Mean Altitude	834.5 km	870km
Others	to **ensure** sun-synchronism	to **ensure** sun-synchronism

[NM] 2.4 System Requirements

The system requirements for the **mid-morning** spacecraft and its ground segment are given in [RD 20].

The system requirements for the afternoon spacecraft and its ground segment are given in [RD 21] and [RD 22].

[NM] 2.5 Downlink Requirements

2.5.1 General

[to be written]

2.5.2 Telemetry/Housekeeping

[to be written]

2.5.3 Stored Data

[to be written]

2.5.4 Direct Broadcast

The NOAA-N, N' spacecraft will provide direct broadcast services using the existing APT and HRPT links as defined in [JBD 1].

The METOP-1, 2 spacecraft will provide direct broadcast services. Their specific implementation for METOP-1, 2 is defined in [JBD 2]. The METOP-1, 2 spacecraft will be built with the capability to allow for both clear and selective transmissions (i.e. per group of instrument, per users). Data encryption policy of the NOAA instruments on-board the METOP spacecraft will be in accordance the Data Denial Memorandum of Understanding (Annex X). Data denial of the LRPT data will be implemented as defined in [RD 32] and selective encryption of the HRPT data as defined in [RD 31].

2.6 Ground Segment Requirements

2.6.1 Satellite Operations

[NM] 2.6.1.1 General

Each Party shall control its own satellites, including the instruments they carry, regardless of their origin.

Day-to-day operations and anomaly resolution will recognize the primacy of **the health and safety of the satellite and** the imaging and sounding missions.

[NM] 2.6.1.2 Cross-support for satellite operations (S-Band)

EUMETSAT shall provide commanding access and housekeeping telemetry acquisition to / from the NOAA satellites for those orbits which are not visible from the NOAA Command and Data Acquisition (CDA) stations, located in Fairbanks and Wallops, and on request for specific operations (e.g. launch and early orbits, contingency...).

NOAA shall provide commanding access and housekeeping telemetry acquisition to / from the EUMETSAT satellites for those orbits which are not visible from the EUMETSAT Polar Command and Data Acquisition Station (PCDAS), located in Northern Europe**,** and on request for specific operations (e.g. launch and early orbits, contingency...).

For this cross-support the ground segments shall operate in a throughput mode (bent-pipe), i.e. without processing of the commands or the telemetry other than that related to the Ground-to-Ground transmission. **Ground- to-Ground transmission includes station events, data quality and command verification**.

The NOAA Ground Segment shall be sized to provide blind orbit cross-support to one operational EUMETSAT satellite; additional requests will be accommodated within that sizing.

The EUMETSAT Ground Segment shall be sized to provide blind orbit cross-support to one operational NOAA satellite; additional requests will be accommodated ~~**on a best effort basis**~~ within that sizing.

[NM] 2.6.1.3 Housekeeping Data Archive and Exchange

NOAA and EUMETSAT shall archive all Housekeeping Data received from their respective satellite.

NOAA shall make available to EUMETSAT**,** on a **agreed upon** basis, the Housekeeping Data of MHS received from the NOAA satellites.

EUMETSAT shall make available to NOAA, on a **agreed upon** basis, the Housekeeping Data of the NOAA provided instruments (refer to section **4.1.1.1)** received from the METOP satellites.

2.6.2 Ground Segment Operations

Each party shall control and operate its own Ground Segment**.**

NOAA and EUMETSAT shall undertake all necessary coordinations to ensure the day to day operation of their respective satellites and ground segments including the cross-support and blind orbit support tasks identified in section 2.6.1.2 and 2.6.3.

[NM] 2.6.3 Data Acquisition and Data Exchange

NOAA and EUMETSAT shall make available to each other the data collected by the IJPS (i.e. including the additional payload), as established in Article 8 of the Agreement.

The provision of **recorded** data shall be made under the following conditions:

NOAA and EUMETSAT shall make available to each other all **data recorded** by their respective operational satellite for those orbits which are visible from their respective data acquisition stations: **PCDA** in Northern Europe for EUMETSAT, CDA stations in

Fairbanks and Wallops for NOAA. **The Ground-to-Ground system design for recorded data exchange will be developed to accommodate each party=s unique operational requirements (i.e. sufficient link data rates, possible data compression and front end processors at the other party=s acquisition station).**

NOAA shall acquire the **recorded** data from the METOP-1 then from the METOP-2 satellites, for those orbits which are not visible from the EUMETSAT PCDA **site**, and shall make them available to EUMETSAT.

EUMETSAT shall acquire the **recorded** data from the NOAA-N **(or, if applicable, NOAA-M)** then from the NOAA-N" satellites, for those orbits which are not visible from the NOAA CDA **stations**, and shall make them available to NOAA.

The **recorded** data from the NOAA N and N' satellite shall be made available at raw data level, i.e the data shall be as received from the satellite**, as described in RDx.**

The **recorded** data from the METOP-1 and METOP-2 satellites shall be made available **at raw data level, i.e the data shall be as received from the satellite[TBC], as described in RDx..**

The **recorded** data shall be made available to the other Party in a timely fashion to ensure the processing of the data from orbit N before starting the acquisition of orbit N + 1.

NOAA and EUMETSAT shall make available to each other all the data necessary to preprocess the instruments data: e.g. satellite ephemeris **or orbital state**, on-board time correlation, instruments calibration parameters.

The detailed requirements and definition of the interface linked to these functions is contained in [JBD 10].

The NOAA Ground Segment shall be sized to provide blind orbit data acquisition to one operational EUMETSAT satellite; additional requests will be accommodated ~~**on a best effort basis**~~ within that sizing.

The EUMETSAT Ground Segment shall be sized to provide blind orbit data acquisition to one operational NOAA satellite; additional requests will be accommodated within that sizing.

The data acquisition stations shall ensure a rolling archive of 7 days of the satellite data acquired by the station***.[Need to confirm this requirement]***

[NM] 2.6.4 Data Processing and Data Distribution

The NOAA and the EUMETSAT Ground Segments shall provide the following functions:

- data ingestion and pre-processing **of** the **recorded** data from both the **mid-morning** and the **afternoon** satellites (i.e sorting of the data, earth location and appending or application of the calibration coefficients, and performance of the associated quality control);

- distribution to the respective user communities of the pre-processed **recorded** data from both the **mid-morning** and the **afternoon** satellites;

- generation **and distribution** of derived products, as requested by the respective user **communities**, from the **recorded** data of both the **mid-morning** and the **afternoon** satellites;

- monitoring of the performance of the instruments, embarked on their respective **satellites,** and of the data and product generation processes by the respective Ground **Segments**;

- maintenance of instrument calibration databases;

- archiving of all **recorded** data and associated data bases, from both the **mid-morning** and **afternoon** satellites, plus all the products generated by the respective ground segments.

[NM] 3 RESPONSIBILITIES

The responsibilities of each Party are stated in the Agreement and are cited **again below in sections 3.2 and 3.3. Joint responsibilities are described in section 3.1.**

[NM] 3.1 Joint Responsibilities

[Include joint documentation which need to be written (i.e Ground-Ground ICD) and the review process/frequency/delivery of the ICDs, etc]

Establish a Joint Configuration Control Board (JCCB) to implement the configuration control procedures described in section 7.8. The JCCB shall comprise the Programme / Project Managers (or their duly appointed representatives) from NOAA, EUMETSAT, NASA and ESA, supported by their Configuration Management Officers (CMO) and cognizant engineers.

3.2 NOAA Responsibilities **[no changes allowed since this section is taken directly from the Agreement]**

NOAA shall:

Spacecraft

Provide the ~~**two**~~ NOAA spacecraft described in section 2.1;

Integrate and test the NOAA and EUMETSAT instruments described in sections 2.2.1 and 2.2.3 into the NOAA spacecraft;

After coordinating scheduling and other launch requirements with EUMETSAT, launch the NOAA spacecraft in time to ensure the uninterrupted availability of visible/infrared imager and sounder data and other data which the parties agree is critical. In particular, NOAA shall be prepared to launch NOAA N" within 120 days of the failure or anticipated failure of NOAA N or of the visible/infrared imager or sounder carried by NOAA N.

Operate the NOAA spacecraft;

Instruments

Provide the instruments as described in section 1.4.2 and 1.4.4 and the data handling subsystem as described in section 2.1 for the NOAA spacecraft

Provide the electrical ground support equipment necessary to test the NOAA-provided instruments when not mounted on the EUMETSAT spacecraft as well as all mechanical and targeting equipment necessary for integration and testing;

Operate and monitor the instruments provided by EUMETSAT on the NOAA spacecraft;

Ground System

Provide a Spacecraft Control Center with backup, a Command and Data Acquisition (CDA) station with backup, and a Data Processing, Distribution and Archive Facility for the NOAA spacecraft as described in section 2.1;

Integrate EUMETSAT instrument procedures with the overall operating procedures for the NOAA satellites;

Provide data access facilities for the EUMETSAT spacecraft during orbits that would otherwise be outside the range of the EUMETSAT CDA station;

Anomaly or Emergency

Assist EUMETSAT in cases of anomaly or emergency situations.

Data Exchange

Make available to EUMETSAT all data collected by the IJP System in a timely manner in accordance with the provisions of Article 8 of the Agreement.

Software

Collaborate with EUMETSAT on development of software to utilize the IJPS data, as appropriate. Such cooperation by the Parties will include exchange of source and object code. ***[policy on further distribution of this code TBC].*** Broad distribution of the resulting software will be on a not-for-profit basis. NOAA may collaborate with EUMETSAT on development of other software, as appropriate, in source and object form, and exchange the resulting software.

3.3 EUMETSAT Responsibilities **[no changes allowed since this section is taken directly from the Agreement]**

EUMETSAT shall:

Spacecraft

Provide the two EUMETSAT spacecraft described in section 2.1;

Integrate and test the EUMETSAT and NOAA instruments described in sections 2.2.1 and 2.2.2 into the EUMETSAT spacecraft;

Launch the EUMETSAT spacecraft after determining the schedule and other launch requirements in coordination with NOAA with the intention of ensuring uninterrupted availability of visible/infrared imager and sounder data and other data the parties agree is critical.

Subject to unforeseen technical contingencies, METOP 2 will be available for launch within 18 months of the launch of METOP 1.

EUMETSAT shall endeavor to launch METOP 2 within 12 months of the unavailability of visible/infrared imager and sounder data and other data the parties agree is critical from METOP 1 except that if such failure occurs within 6 months of the launch of METOP 1, when EUMETSAT shall endeavour to launch METOP 2 as soon as possible.

Operate the EUMETSAT spacecraft;

Instruments

Provide the instruments as described in sections 1.4.3 and 1.4.4 and the data handling subsystem as described in section 2.1 for the EUMETSAT spacecraft;

Provide the electrical ground support equipment necessary to test the EUMETSAT-provided instrument when not mounted on the NOAA spacecraft, as well as all mechanical and targeting equipment necessary for integration and testing;

Operate and monitor the instruments provided by NOAA on the EUMETSAT spacecraft;

Ground System

Provide a Spacecraft Control Center with backup, a Command and Data Acquisition (CDA) station with backup, and a Data Processing, Distribution and Archive Facility for the EUMETSAT satellites as described in section 2.1;

Integrate NOAA instrument procedures with the overall operating procedures for the EUMETSAT satellites;

Provide satellite data access facilities for the NOAA spacecraft during orbits that would otherwise be outside the range of the NOAA CDA station;

Anomaly or Emergency

Assist NOAA in cases of anomaly or emergency situations.

Data Exchange

Make available to NOAA all data collected by the IJP System in a timely manner in accordance with the provisions of Article 8 of the Agreement.

Software

Collaborate with NOAA on development of software to utilize the IJPS data, as appropriate. Such cooperation by the Parties will include exchange of source and object code. Broad distribution of the resulting software will be on a not-for-profit basis. EUMETSAT may collaborate with NOAA on development of other software, as appropriate, in source and object form, and exchange the resulting software.

[NM] 4 DELIVERABLES, TASKS AND SERVICES ASSOCIATED **WITH** THE SPACE SEGMENT

4.1 Deliverables from NOAA to EUMETSAT

4.1.1 Hardware

[NM] 4.1.1.1 Instruments

NOAA shall provide to EUMETSAT the following instrument models for flight on METOP-1, METOP-2 and for use on the METOP EM spacecraft; ~~**as well as flight / integration spare**~~:

- ~~**3**~~ **2 (two)** flight standard copies of AVHRR/3;
- ~~**3**~~ **2 (two)** flight standard copies of AMSU-A1;
- ~~**3**~~ **2 (two)** flight standard copies of AMSU-A2;
- 2 **(two)** flight standard copies of HIPS/4;
- 2 **(two)** flight standard copies of SARR;
- ~~**3**~~ **2 (two)** flight standard copies of **SARP-3;**
- **2 (two) flight standard copies of SEM-2.**

The provided instruments will be developed according to the requirement specifications identified in paragraph 2.2.1.

The delivery site is one of the METOP Spacecraft integration **sites** in Europe.

The delivery dates are identified in a separate, jointly agreed Deliverable Items List (DIL).

It is agreed that, in principle, the instruments provided by NOAA will be the same as those procured for the NOAA-K,L,M spacecraft; changes are, however, not excluded. Any such change will be limited to spacecraft to instrument interface changes arising from major accommodation issues / problems. To achieve flexibility during AIT, it is aimed to maintain ~~**commonality**~~ **interchangability** between the instruments to be flown on NOAA-N and N' and those to be flown on METOP-1 and 2.

It is recognized that the NOAA provided instruments are being built to existing designs and to given environmental levels. All reasonable efforts will be spent in the METOP design to accommodate these known levels. Any discrepancies will be negotiated. **Providing the expected and tested environmental levels for the test remains the**

responsibility of the spacecraft provider.

Following the satisfactory performance of the post-transport (incoming) functional test at the METOP Spacecraft integration site and the acceptance of the Pre-shipment data package by

the Party responsible for the spacecraft, the instrument will be handed over to the spacecraft integrator for subsequent AIT tasks at spacecraft level**.**

NOAA shall ensure the availability of spare flight units for each of these instruments for use on METOP-1, 2 through NOAA=s provision of these instruments for NOAA-N, N=. A single flight spare unit shall be used to support both the TIROS and the METOP programs and it is intended that this spare would, nominally, be kept in the U.S. to support the NOAA program. However, should a crisis situation develop which threatens the continuity of service on the mid-morning or afternoon orbit, the Parties may consider it to be in the best interests of the IJPS to ship the flight spare unit to, respectively, the EUMETSAT spacecraft contractor or the NOAA spacecraft contractor (on such occasions, due consideration will be given, inter alia, to the closer to launch satellite). When no longer required the receiving party shall ensure its immediate return to the other Party.

NOAA will undertake the refurbishment (if necessary) of instruments used for the METOP Engineering Model spacecraft, for use as flight units. NOAA will undertake the troubleshooting, repair and recalibration of instruments, if required, after delivery, under modalities to be agreed.

Components / other alerts (e.g. Government Industry Data Exchange Programme) will be monitored by NOAA / EUMETSAT for their respective deliverables and will be advised to the other party when applicable to the delivered hardware. Corrective action will be carried out under modalities to be agreed, and under the responsibility of the supplier.

4.1.1.2 Ground Support Equipments

NOAA shall provide to EUMETSAT, for each of the instruments identified in the previous paragraph, a set of Ground Support Equipment. This set shall be specified in each of the METOP Instrument Interface Control Documents.

The delivery date and number of items are identified in a jointly agreed, separate Deliverable Items List.

The delivery site for these items is one of the METOP spacecraft integration sites in Europe.

4.1.2 Documentation

4.1.2.1 NOAA Provided Instruments

NOAA shall provide to EUMETSAT, for each of the instruments identified in paragraph 4.1.1.1. the documentation necessary to integrate those instruments on the METOP spacecraft, to verify their proper functioning and to process their data. It is expected that such documentation will encompass, but not necessarily be limited to, the items hereunder. The precise identification of the documents, the number of copies and the delivery dates are identified in a jointly agreed, separate Document Requirements List (DRL). This information will, in principle, be supplied via existing documents from the development contracts. Exchange of documentation will follow the rules of article 7 of the Agreement, in particular, concerning proprietary information.

a. Instrument Requirements

- Instruments Technical / Performance Requirements;

- Instruments Performance Assurance Requirements.

b. Instruments Review Data Packages

- Data Packages for major reviews as defined in section 7.3.

c. AIT/AIV activities

- Instruments Environmental Design and Test Plan; this shall identify the tests the instrument will be subject to at instrument level; the Qualification (when applicable) and acceptance test procedures will be sent for review at least four weeks prior to the tests.

- Instruments Data and Calibration / characterization Log Books; it shall contain (in a single or separate files) the actual measured characteristics of each unit: internal alignments, FOV, antenna radiation patterns, bandpass characteristics, mass properties, calibration of scientific and HSK TM, scientific characterization...

- Qualification (when applicable) and Acceptance Test Results including environmental test results (part of the pre-shipment data package).

- Instruments Spacecraft Level Operation and Maintenance Manual; under the form of a consolidated file this shall include, in particular:

. instrument handling and safety requirements;
. any instrument special requirements (e.g. purging);
. instrument functional operating procedure;

. procedures for:
. pre-installation bench checkout;
. spacecraft ambient and thermal vacuum test;
. instrument calibration (thermal vacuum or ambient conditions, as appropriate);
. bench checkout test equipment operation and maintenance;

. thermal vacuum target operation and maintenance;

- Instrument In-orbit Calibration / Characterization procedures.

d. Product Assurance Activities

- Declared Materials / Processes and components lists;

- FMECA of the interface equipments;

- Contamination and Cleanliness Control documentation;

- EKE Reliability documents for the interface circuits.

e. Configuration Control

- Change Requests, requests for waivers, requests for deviations (as per paragraph 7.8).

- Baseline Configuration Status List, defining the baseline design/build standard of the deliverable hardware, and the basis against which changes, discrepancies and waivers may be raised; document to be jointly agreed with EUMETSAT.

f. Technical Notes, Various inputs

Under the form of ad hoc technical notes, minutes of meeting... information will be provided covering in particular the following topics:

- Inputs to the METOP Instrument ICDs; this shall cover, in particular:

. outline / mechanical interface control drawings (including fields of view);
. instrument mass, center of gravity, moments of inertia;
. thermal control drawings;
. drill template drawings;
. instrument test fixture drawings;
. instrument disturbance and torque characteristics;
. alignment requirements;

. electrical interface drawings (up to the first active elements) and including grounding diagrams;
. connector and pin allocations;
. current and power profiles;
. EMC / EMI issues;
. command and control interface (commands and telemetry formats, requirements toward the spacecraft Data Management System);
. GSE related issues;
. tests at the spacecraft integration site.

These inputs shall be generated as required for spacecraft interface meetings, and shall be reviewed at the major reviews.

- Inputs to Spacecraft Flight Operations Manual, providing:

. a description of the functionality of the instrument;
. switch-on and commissioning procedures;
. operating constraints;
. nominal operations;
. contingency.

- Inputs to the Spacecraft GSE processing requirements: to allow the Spacecraft GSE contractor to establish the Software Requirement Document for the processing and handling of the instruments when tested at spacecraft level.

- Inputs for the Launcher Safety File.

4.1.2.2 MHS

NOAA shall provide to EUMETSAT for the MHS the following documents:

- Unique Instrument Interface Specification; aiming to define all the interface items between the spacecraft and the instrument, it will cover, in particular:

. electrical interface;
. mechanical interface;
. thermal interface;
. environmental interface (magnetic, EMI, flight environment);
. operational requirements and precautions (in-flight and on-ground);
. test equipments and services (to be provided by the instruments and the spacecraft side);
. definition of the tests performed at the satellite integration site;

- EGSE Processing Software Description; it will describe the software implemented for

MHS testing within the Advanced Tiros Aerospace Ground Equipment;

- MHS Spacecraft level test procedures (for review, to be sent at least 4 weeks before the tests);

- MHS spacecraft level test results;
- Data packages related to MHS interfaces for major spacecraft or sub-system reviews.

- On-orbit verification test plan.

[NM] 4.1.3 Software Models

NOAA shall provide to EUMETSAT, for each of the instruments identified in paragraph 4.1.1.1. a set of software with their associated documentation. This set shall be specified in each of the METOP Instrument Interface Control Documents. It is expected that it will encompass but not necessarily be limited to, the items hereunder. They are specified in [JBD 29] in [JBD 30]. Their precise identifications, and delivery dates are specified in Deliverable Items List.

a. Finite Element Model ; a NASTRAN finite element model representation of the instrument having the fewest number of gridpoints that will accurately define the instrument dynamic characteristics

b. Reduced ~~**Surface**~~ **Structural** Model; in ESATAN standard

c. Reduced Thermal Model; in ESABASE

4.2 Tasks and Services provided by NOAA

The following services will be provided by NOAA either directly or through delegation to the NASA/GSFC POES Project (see paragraph 7.2).

4.2.1 Individual Tasks

Refer to section 3.1

4.2.2 Joint engineering tasks

NOAA shall jointly with EUMETSAT:

- define and maintain the key performance parameters of the IJPS;

- perform the engineering tasks related to the accommodation of the NOAA provided

instruments on the METOP-1 and 2 spacecraft;

- perform the engineering tasks related to the accommodation of the MHS instrument on the NOAA-N and N' spacecraft and, in particular, establish and maintain the corresponding Unique Instrument Interface Specification.

- establish and maintain a configuration control process as per section 7.8.

4.2.3 AIT Tasks related to the EUMETSAT provided instruments

NOAA shall integrate and test the MHS instruments on the NOAA-N and NOAA-N' spacecraft. The definition of the activities and tests performed at the spacecraft contractor. facility is included in the Unique Instrument Interface Specification.

4.2.4 Support Tasks Related to the NOAA Provided Instruments

[NM] 4.2.4.1 Pre-launch

NOAA shall provide the following support to the METOP-1 and 2 pre-launch activities, related to the NOAA provided instruments:

a) <u>planned support</u>

- support to definition of instrument to spacecraft EGSE interface, including science data interpretation **(i.e. calibration)** and automatic test procedure design;

- support to METOP system level reviews;

- performance of post-transport (incoming) instrument functional test at the METOP spacecraft integration site;

- support to mechanical and electrical integration;

- support to electrical performance tests at spacecraft level;

- support to environmental test at spacecraft level;

- support to the launch campaign;

- support to the flight acceptance review;

- support to the preparation for launch and operations;

- maintenance of the provided GSE, including software.

- support to pre-launch calibration activities

- support the definition, provision and use of equipment to verify telemetry and command compatibility at spacecraft level and at end-to-end operational level.

- support for compatibility of NOAA-provided instruments on the METOP spacecraft.

b) ad-hoc support

- trouble shooting on instruments;

- repair of delivered hardware after failure;

- debugging of the instrument related elements of the spacecraft EASE.

[NM] 4.2.4.2 Post-Launch

EUMETSAT is responsible for the post-launch checkout, commissioning and operations of the METOP-1 and 2 satellites. NOAA shall provide the following support to the METOP-1 and 2 post-launch activities, related to the NOAA provided instruments:

a) planned support

- in-orbit commissioning of instruments; evolution of flight operations procedures; performance evaluation; calibration and characterization;

- support to the commissioning review;

- support to the routine in-orbit performance assessment of the instruments, support to the regular performance reviews

b) ad-hoc support

- support to the investigation and response to in-orbit anomalies and emergency situations.

4.3 Deliverables from EUMETSAT to NOAA

4.3.1 Hardware

. 4.3.1.1 Instruments

EUMETSAT shall provide to NOAA the following instrument models:

- 2 (two) copies of MHS for flight on NOAA-N and N'.

The provided instruments will be developed according to the requirement specifications identified in paragraph 2.2.1.

The delivery site is the NOAA Spacecraft integration site.

The delivery dates are identified in a separate, jointly agreed, Deliverable Items List (DIL).

EUMETSAT shall ensure the availability of a spare MHS flight unit for use on NOAA-N, N= through EUMETSAT's provision of MHS for METOP-1,-2. A single flight spare unit shall be used to support both the TIROS and the METOP programmes and it is intended that this spare would, nominally, be kept in Europe to support the METOP programme. However, should a crisis situation develop which threatens the continuity of service on the morning or afternoon orbit, the Parties may consider it to be in the best interests of the IJP System to ship the flight spare unit to, respectively, the NOAA spacecraft contractor or the METOP spacecraft contractor (on such occasions, due consideration will be given, inter alia, to the closer to launch satellite). When no longer required the receiving party shall ensure its immediate return to the other Party.

Testing to the specified environmental levels for acceptance of flight units and ensuring the proper qualification of instruments remains the responsibility of the instrument supplier.

Following the satisfactory performance of the post-transport (incoming) functional test at the NOAA Spacecraft integration site and the acceptance of the Pre-shipment data package by the Party responsible for the spacecraft, the instrument will be handed over to the spacecraft integrator for subsequent AIT tasks at spacecraft level.

EUMETSAT will undertake the trouble-shooting, repair and recalibration of instruments, if required, after delivery, under modalities to be agreed.

Components / other alerts (e.g. Government Industry Data Exchange Programme) will be monitored by NOAA / EUMETSAT for their respective deliverables and will be advised to the other party when applicable to the delivered hardware. Corrective action will be carried out under modalities to be agreed, and under the responsibility of the supplier.

4.3.1.2 Ground Support Equipments

EUMETSAT shall provide to NOAA, for the MHS, a set of Ground Support Equipment. This set shall be specified in the Unique Instrument Interface Specification.

The delivery date and number of items are identified in a jointly agreed, Deliverable Items List.

The delivery site for these items is the NOAA Spacecraft Contractor facility.

4.3.2 Documentation

4.3.2.1 MHS

EUMETSAT shall provide to NOAA, for the MHS the documentation necessary to integrate it on the NOAA spacecraft, to verify its proper functioning and to process its data. It is expected that such documentation will encompass, but not necessarily be limited to, the items hereunder. The precise identification of the documents, the number of copies and the delivery dates are identified in a jointly agreed, separate, Document Requirements List. This information will, in principle, be supplied via existing documents from the development contract. Exchange of documentation will follow the rules of article 7 of the Agreement, in particular, concerning proprietary information.

a. Instrument Requirements

- Instrument Performance and Functional Specification;

- Instrument Product Assurance Requirements;

b. Instrument Review Data Packages

- Data package for instrument major reviews as defined in section 7.3.

c. AIT/AIV activities

- Instruments AIT Plan; this shall identify the tests the instrument will be subject to at instrument level; the qualification and acceptance test procedures will be sent for review at least four weeks prior to the tests.

- Instruments Data and Calibration / Characterization Log Books; it shall contain (in a single or separate files) the actual measured characteristics of each unit: internal alignments, FOV, antenna pattern bandpass characteristics, mass properties, calibration of scientific and HSK TM, scientific characterization.....

- Qualification and Acceptance Test Results including environmental test results (part of

the Flight Acceptance Review data package).

- Instruments Spacecraft Level Operation and Maintenance Manual; under the form of a consolidated file this shall include, in particular:

  . instrument handling and safety requirements;
  . any instrument special requirements (e.g. purging); instrument functional operating procedure;
  . procedures for:
  . pre-installation bench checkout;
  . spacecraft ambient and thermal vacuum test;
  . instrument calibration (thermal vacuum or ambient conditions, as appropriate);
  . bench checkout test equipment operation and maintenance.
  . thermal vacuum target operation and maintenance;
  . test data reduction and correlation requirements.

- Instrument In-orbit Calibration / Characterization procedures.

d. Product Assurance

- Declared Materials / Processes and components lists;

- FMECA of the interface equipments;

- Contamination and Cleanliness Control documentation;

- EEE Reliability documents for the interface circuits.

e. Configuration Control

- Change Requests, requests for waivers, requests for deviations (as per paragraph 7.8).

- Baseline Configuration Status List, defining the baseline design/build standard of the deliverable hardware, and the basis against which changes, discrepancies and waivers may be raised; document to be jointly agreed with NOAA.

f. Technical Notes, Various **Inputs**

Under the form of ad hoc technical notes, minutes of meeting... information will be provided covering in particular the following topics:

- Inputs to the UIIS; this shall cover, in particular:
  . outline / mechanical interface control drawings (including fields of view);
  . instrument mass, center of gravity, moments of inertia;

. thermal control drawings;
. drill template drawings;
. instrument test fixture drawings;
. instrument disturbance and torque characteristics;
. alignment requirements;
. electrical interface drawings (up to the first active elements) and including grounding diagrams;
. connector and pin allocations;
. current and power profiles;
. EMC / EMI issues;
. command and control interface (commands and telemetry formats, requirements toward the spacecraft Data Management System);
. GSE related issues;
. tests at the spacecraft integration site.

These inputs shall be generated as required for spacecraft interface meetings, and shall be reviewed at the major reviews.

- Inputs to Spacecraft Flight Operations Manual, providing:

. a description of the functionality of the instrument;
. switch-on and commissioning procedures;
. operating constraints;
. nominal operations;
. contingency.

- Inputs to the Spacecraft GSE processing requirements: to allow the Spacecraft GSE contractor to establish the Software Requirement Document for the processing and handling of the instruments when tested at spacecraft level.

- Inputs for the Launcher Safety File.

[NM] 4.3.2.2 NOAA **Provided Instruments**

EUMETSAT shall provide to NOAA for each of the instruments listed in paragraph 4.1.1.1. the following documentation:

- METOP Instrument Interface Control Documents **(ICDs)**; aiming to define all specific features of the interface between the spacecraft and each individual instrument, covering, in particular:

. mechanical interface;
. thermal interface;
. electrical interface;

. EMC / RFC interface;
. cleanliness and space environment design constraints;
. instrument design verification;
. ground support equipment;
. ground operation; flight operation;
. product assurance and reliability.

- EGSE Processing Software Description; it will define the software implemented for the testing of the NOAA provided instruments within the METOP EGSE;
- Spacecraft Level AIT Plan, as related to the NOAA instruments;

- Spacecraft level test procedures, as related to the NOAA instruments, (for review, to be sent at least 4 weeks before the tests);

- Spacecraft level test results, as related to the NOAA instruments;

- Major METOP System Reviews presentation data packages;

- Major METOP System Reviews technical data package dedicated to NOAA instruments;

- In-orbit test and operation plans and procedures.

4.3.3 Software Models

EUMETSAT shall provide to NOAA for the MHS a set of software models with their associated documentation. This set shall be specified in the Unique Instrument Interface Specification document. It is expected that it will encompass but not necessarily be limited to the items hereunder. Their precise identifications, and delivery dates are specified in the Deliverable Items List.

a. Finite Element Model; a NASTRAN finite element model representation of the instrument having the fewest number of gridpoints that will accurately define the instrument dynamic characteristics

b: Reduced ~~**Surface**~~ **Structural** Model; in TRASYS standard (in tabular form)

c. Reduced Thermal Model; in SINDA standard

4.4 Tasks and Services provided by EUMETSAT

The following tasks and services will be provided by EUMETSAT either directly or jointly with ESA (see paragraph 7.2).

4.4.1 Individual Tasks

Refer to section 3.2

4.4.2 Joint Engineering Tasks

EUMETSAT shall jointly with NOAA:

- define and maintain the key performance parameters of the IJPS.
- perform the engineering tasks related to the accommodation of the NOAA provided instruments on the METOP-1 and METOP-2 spacecraft and, in particular, establish and maintain the corresponding Unique ~~**Interface Control Documents**~~ Instrument Interface Specification documents;

- perform the engineering tasks related to the accommodation of the MHS instrument on the NOAA-N and NOAA-N' spacecraft;

- establish and maintain a configuration control process as per section 7.8.

4.4.3 AIT Tasks Related to the NOAA Provided Instruments

EUMETSAT shall integrate and test the NOAA provided instruments on the METOP-1 and METOP-2 spacecraft. The definition of the activities and tests performed at the spacecraft contractor plant is included in the METOP Instrument ICDs.

4.4.4 Support Tasks Related to MHS

[NM] 4.4.4.1 Pre-launch

EUMETSAT shall provide the following support to the NOAA-N and N' pre-launch activities, related to the MHS instrument:

a) <u>planned support</u>

- support to NOAA system level reviews;

- support to definition of instrument to spacecraft EGSE interface, including science data interpretation **(i.e. calibration)** and automatic test procedure design;

- performance of post-transport (incoming) instrument functional test at the NOAA Spacecraft integration site;

- support to mechanical and electrical integration;

- support to electrical performance tests at spacecraft level;

- support to environmental test at spacecraft level;

- support to the launch campaign;

- support to the flight acceptance review;

- support to the preparation for launch and operations;
- maintenance of the provided GSE, including software

- support to pre-launch calibration activities

- support the definition, provision and use of equipment to verify telemetry and command compatibility at spacecraft level and at end-to-end operational level.

- support for compatibility of MHS on the NOAA spacecraft.

b) ad-hoc support

- trouble shooting on instrument;

- repair of delivered hardware after failure:

- debugging, instrument related elements of the ATNAGE.

[NM] 4.4.4.2 Post-Launch

NOAA is responsible for the post-launch checkout, commissioning and operations of the NOAA-N and N' satellites. EUMETSAT shall provide the following support to the NOAA-N and NOAA-N' post launch activities, related to the MHS instruments:

a) planned support

- in-orbit commissioning of instruments; evolution of flight operations procedures; performance evaluation; calibration and characterization;

- support to the commissioning review;

- support to the routine in-orbit performance assessment of the instruments, support to the regular performance reviews.

b) ad-hoc support

- support to the investigation and response to in-orbit anomalies and emergency situations.

5 DELIVERABLES, TASKS AND SERVICES ASSOCIATED TO THE GROUNDSEGMENTS DEVELOPMENT

[NM] 5.1 General

NOAA and EUMETSAT will exchange deliverables and perform tasks and services for the design, the development, the testing, the validation and the operations preparation of their respective Ground Segments as described in section 2.6.

This shall cover in particular:

- Space to Ground and Ground to Ground interface engineering;

- the development of the scientific data (pre-)processing algorithms.

NOAA shall be responsible for producing the NOAA-N, -N' to Ground ICD, while EUMETSAT shall be responsible for producing the METOP-1, -2 to Ground ICD. **In addition both parties will be responsible for production of the IJPS Ground-to-Ground ICD**.

Adequate scientific cooperation between the two Parties shall be maintained for the scientific data (pre-) processing. This cooperation shall be supported by the exchange of the documentation and software (including data bases) used to process the instrument data. Each Party shall however be free to develop and use its own processing chains. ***[@provided the general aim of "equivalence" of the results is maintained@ - TBC].***

[NM] 5.2 NOAA Responsibilities

The NOAA main responsibilities are recalled in section 3.1. They are further detailed hereunder. NOAA shall:

- develop, integrate and validate a NOAA Ground Segment fulfilling the functions

described in section 2.6;

- provide to EUMETSAT all information concerning the NOAA Space to Ground Iinks necessary for EUMETSAT to design a ground segment capable of insuring the tasks outlined in section 2.6 and **for EUMETSAT to** establish and maintain a NOAA Space to Ground Interface Document **for the METOP PCDA**; ***[add to the JBD or RD lists]***

- provide to EUMETSAT all information concerning the Ground to Ground interface necessary for EUMETSAT to design a ground segment capable of **ensuring** the data exchange and the operation coordination outlined in section 2.6;

- provide support to EUMETSAT for the test and the validation of the EUMETSAT Ground Segment for what concerns all the interface functions with NOAA;

- provide to EUMETSAT data packages for major Ground Segment reviews as outlined in section 7.3;

- provide to EUMETSAT all necessary information for the understanding of preprocessing and product processing algorithm to include descriptions, architectural design and interface documents as well as user and maintenance manuals; this cooperation shall include exchange of source and object code, data sets and test data / procedures with expected results;

- collaborate with EUMETSAT, as appropriate, on development of ground system;

- provide to EUMETSAT any NOAA unique command and / or data acquisition equipment required to perform the data acquisition, the housekeeping telemetry acquisition**, the commanding access and the data handling** from / to the NOAA satellite; the identification of such equipments will be jointly agreed;

- provide to EUMETSAT all necessary training for operating **and maintaining** such unique equipments.

The delivery date and number of items to be delivered shall be identified in a jointly agreed, separate Deliverable Items List (DIL) and Documentation Requirement List (DRL).

[NM] 5.3 EUMETSAT Responsibilities

EUMETSAT main responsibilities are recalled in section 3.2. They are detailed hereunder. EUMETSAT shall:

- develop, integrate and validate a EUMETSAT Ground Segment fulfilling the functions

described in section 2.6;

- provide to NOAA all information concerning the METOP Space to Ground links necessary for NOAA to design a ground segment capable of insuring the tasks outlined in section 2.6 and establish and maintain a METOP Space to Ground Interface Document;

- provide to NOAA all information concerning the Ground to Ground interface necessary for NOAA to design a ground segment capable of insuring the data exchange and the operation coordination outlined in section 2.6 and establish Ground to Ground Interface Documents;

- provide support to NOAA for the test and the validation of the NOAA Ground Segment for what concerns all the interface functions with EUMETSAT and, in particular, provide the necessary test equipments to validate the Space to Ground
- provide to NOAA data packages for major Ground Segment reviews as outlined in section 7.3;

- provide to NOAA all necessary information for the understanding of pre-processing and processing algorithm to include descriptions, architectural design and interface documents as well as user and maintenance manuals; this cooperation shall include exchange of source and object code, data sets and test data / procedures with expected results.

- collaborate with NOAA, as- appropriate, on development of ground system;

- provide to NOAA any EUMETSAT unique command and / or data acquisition equipment required to perform the data acquisition, the housekeeping telemetry acquisition**, the commanding access and the data handling** from / to the METOP satellite; the identification of such equipments will be jointly agreed;

- provide to NOAA all necessary training for operating **and maintaining** such unique equipments.

The delivery date and number of items to be delivered shall be identified in the jointly agreed, Deliverable Items List (DIL) and Documentation Requirement List (DRL).

[NM] 5.4 Joint Tasks

NOAA and EUMETSAT shall jointly:

- perform the engineering tasks related to the NOAA-N and NOAA-N' and the METOP-1 and METOP-2 Space to Ground interface; this shall, in particular, include participation **in** reviews;

- develop and approve the Ground-to-Ground Interface Control Document;

- perform the engineering tasks related to the Ground-to Ground interface; this shall, in particular, include participation **in** reviews;

- be responsible for the procurement of the communication resources required for the NOAA / EUMETSAT Ground-to-Ground interface, following, jointly agreed, rules.

- perform the tasks related to the preparation for operations and coordination of their respective Ground Segment; **these include the definition, provision and use of equipment to verify telemetry and command compatibility at spacecraft level and at an end-to-end operational level;**

- establish and maintain a scientific cooperation for the development of ground system software to utilize the IJPS data;

- coordinate the implementation of the (upgraded) HRPT and LRPT direct broadcast links;

6 OPERATIONAL PHASE

[NM] 6.1 **During the Operational Phase NOAA shall**;

- make available to EUMETSAT the global data from the NOAA satellites and the METOP satellites as per section 2.6.

- provide to EUMETSAT housekeeping telemetry acquisition and commanding access from / to the METOP satellites as per section 2.6.

- provide to EUMETSAT in a timely fashion:

- **all information (i.e. operational requests, orbit state vector, on-board time correlation...) necessary to perform the operational planning and actual operations of the respective Ground Segments and Satellites;**

- **all instrument information (i.e. pre-processing changes, calibration parameters updates, etc...) necessary to sustain operational data / products generation;**

- continue the scientific cooperation initiated in the development phase (refer to chapter 5)

- provide to EUMETSAT the on-orbit support described in section 4.2.4.2.

- coordinate with EUMETSAT on major configuration changes of on-orbit assets.

- provide to the user community sufficient information to determine the orbit and the instrument pointing.

- monitor the health and safety of all instruments on the NOAA satellites.

[NM] 6.2 **During the Operational Phase EUMETSAT shall;**

- make available to NOAA *all of the recorded* data from the NOAA satellites and the METOP satellites as per section 2.6.
- provide to NOAA housekeeping telemetry acquisition and commanding access from / to the NOAA satellites as per section 2.6.

- provide to NOAA in a timely fashion:

- **all information (i.e. operational requests, orbit state vector, on-board time correlation...) necessary to perform the operational planning and actual operations of the respective Ground Segments and Satellites;**

- **all instrument information (i.e. pre-processing changes, coefficient calibration updates, etc...) necessary to sustain operational / products generation;**

- continue the scientific cooperation initiated in the development phase (refer to chapter 5).

- provide to NOAA the on-orbit support described in section 4.4.4.2.

- coordinate with NOAA on major configuration changes of on-orbit assets.

- monitor the health and safety of all instruments on the METOP satellites.

7 PROGRAM MANAGEMENT

7.1 General

The following set of ground rules shall be the basis for the management structure and the

management procedures put in place to implement the objectives of the Agreement.

- The development of the NOAA and the EUMETSAT elements of the IJPS shall be conducted as closely coordinated but independent programs. Coordination and visibility are required and will be implemented to ensure:

  . the technical coherence of the IJPS (coherence of the key performance parameters, proper implementation of the interfaces);

  . the programmatic coherence of the development and of the deployment of the IJPS (visibility of schedules, coordination of actual launch dates...).

- ***Each Party shall bear the costs of fulfilling its respective responsibilities. There shall be no exchange of funds between NOAA and EUMETSAT - TBC.***

- The teams shall be encouraged to solve engineering problems at a working level. Decisions, disagreements shall be brought up at the Program Managers level. If the Program Managers cannot settle the disputes, the procedures of article 12 of the Agreement shall be used.

7.2 Management Structure

[NM] 7.2.1 NOAA **Management Structure**

The signatory of the Agreement is the NOAA Administrator. Within NOAA, NOAA / NESDIS has the overall program management authority and provides final determination over changes in scope of the System. NOAA/NESDIS liaises with CNES for provision of DCS and SARP and with DND of Canada for provision of SARR. NOAA/NESDIS develops and implements changes in the ground system, operates the satellites and produces products from the IJPS data. ~~**NOAA / NESDIS coordinates with the National Polar-orbiting Operational Satellite System (NPOESS) Integrated Program Office on issues related to the NPOESS**~~. Program Authority for POES is the POES Program Manager in NESDIS.

NOAA/SAO provides acquisition management oversight of the NOAA spacecraft, AVHRR, HIRS, AMSU-A and SEM. NOAA/SAO executes the satellite acquisition within the Program Management framework established by the NESDIS Program Manager. NOAA/SAO provides NOAA oversight of NASA acquisition activities. NOAA/SAO also oversees the technical aspects linked to the provision and integration of the DCS and S&R instruments.

On behalf of NOAA, the National Aeronautics and Space Administration, Goddard Space Flight Center (NASA/GSFC) has the overall systems responsibility for the management,

procurement, integration and testing of, the NOAA provided instruments, related GSE, the NOAA-N and NOAA-N' satellites as described in a separate Memorandum of Understanding between NASA and the U.S. Department of Commerce.

The NASA / GSFC POES Project Office, Code 480, has been assigned responsibility for the overall management, procurement and launch of the NOAA environmental satellites. The NASA /GSFC POES Project Office, in its role as system development manager, has been designated as the responsible organization with authority to define, control and enforce all instrument interface requirements with the spacecraft.

[NM] 7.2.2 EUMETSAT **Management Structure**

The signatory of the Agreement is the Director of EUMETSAT. The implementation of the Agreement on the EUMETSAT side is performed in the frame of the EUMETSAT Polar System. The program management authority for the EUMETSAT Polar System lies with the Low Earth Orbit division in the Technical Department of EUMETSAT.

Under a separate agreement, the development of the EUMETSAT Polar System satellites is a cooperative development with ESA by which:

Following text in italics to be updated by M. Langevin / P.G. Edwards.

As part of its EPS / METOP programme, EUMETSAT, inter alia:

develops, procures and funds the MHS instrument;
liaises with CNES (and other partners) to ensure the availability of 2 flight models of the IASI instrument;
procures and funds the launchers for METOP-I and METOP-2;
funds the METOP-2 spacecraft;
develops, procures and funds the EPS Ground Segment;
operates the satellites and the EPS Ground Segment;

As part of its METOP-I programme, ESA, inter alia:
develops, procures and funds the METOP-I spacecraft to be the prototype of an operational series; it integrates and test the satellite comprising the payload described in sections 2.2.1 and 2.2.2;
procures, integrates and tests the METOP-2 satellite;
develops, procures and funds two flight models of the ASCAT and the MIMR for flight on METOP-I and METOP-2;
liaises with a third party and CNES to ensure the availability of two flight models of, respectively, the OMI and the ScaRaB instruments;
develops an ESA/METOP Application Ground Segment which covers, interalia, the development, for transfer to EUMETSAT during the nominal life of METOP, of agreed operational processing chains for the ESA-supplied instruments.

[NM] 7.2.3 Points of contacts, lines of communications

For all program level issues, the formal approval / communication path from or to NASA or ESA is through NOAA / EUMETSAT. Should technical issues associated with the accommodation of the NOAA provided instruments on METOP-1 and METOP-2 arise, NASA and ESA may resolve these problems directly with disposition, information provided to NOAA and EUMETSAT. In a similar fashion, should technical issues associated with the accommodation of the MHS on NOAA-N and N" arise, NASA and EUMETSAT may resolve these problems directly with disposition, information provided to NOAA.

While the parties are encouraged to solve engineering problems at working level, any decision potentially affecting either the hardware, the software to be developed / exchanged or affecting significantly the tasks to be performed, shall be valid only when fully documented and approved by the Program / Project Managers or their duly appointed representatives. The procedures related to configuration control are defined in section 7.8 below.

The Parties will exchange by letters the names of the designated Program / Project Managers. Those will, in turn, exchange the organigrams defining the internal organization of their teams and will provide updates as appropriate.

Specific points of contact for EUMETSAT and NOAA are listed in RDX.

7.3 Project Management, Reviews

Each Party will conduct the development of its IJPS elements according to its standard practice. Formal reviews will be held at key milestones of the development.

The following reviews are identified as the minimum set of reviews to which each Party will attend. Each Party will be invited to other potential reviews including lower level reviews (e.g. on critical items), if found mutually beneficial.

a) NOAA provided instruments reviews

As the NOAA instruments for NOAA-N and N" and for METOP-1 and METOP-2 are drawn from an existing design, they are subject to a limited review cycle aimed to assess the impacts of changes from the previous instrument procurement.

- (delta) Critical Design Review (CDR); the objectives of this review are to confirm the detailed design and performance of the instrument (impacts of eventual changes) and to authorize the FM manufacture;.

- Pre-Environmental Review (PER); the objective of this review is to confirm the readiness of each instrument prior to environmental testing;

- Pre-Shipment Review (PSR); the objectives of this review are to confirm the (qualification) / acceptance status of each instrument unit and to authorize its shipment to the METOP Spacecraft Contractor. The instruments shall be shipped only if EUMETSAT agrees with the disposition of the issues raised at the PSR.

b) MHS reviews

- System Concept Review (SCR); the objective of this review is to review the design of the MHS and its constituent subsystems / equipments.

- Preliminary Design Review (PDR); the objectives of this review are to confirm the instrument design and to authorize the manufacturing of the Engineering Model.

- Critical Design Review (CDR); the objectives of this review are to confirm the detailed design and performance of the instrument and to authorize the FM manufacture;

- Test Readiness Review (TRR); the objective of this review is to confirm the readiness of each instrument flight model to commence environmental testing;

- Flight Acceptance Review (FAR) / Pre-shipment Review; the objectives of this review are to confirm the (qualification) / acceptance stems of each instrument unit and to authorize its shipment to the NOAA Spacecraft Contractor or its storage; A pre-shipment review shall be held after storage. The instrument shall be shipped only if NOAA agrees with the dispositions of the issues raised by the FAR / PSR.

c) NOAA-N and N' reviews

- Reviews related to the MHS Interface Unit (PDR, CDR etc.);

- Pre-Environmental Test Review; the objectives of this review are to confirm the readiness status of each satellite (NOAA-N and N') prior to environmental testing;

- Instrument readiness review; the objectives of this review are to confirm acceptability of each instrument's test performance, final calibration curves, ground system status (e.g. databases, software configuration) in preparation for launch;

- Pre-Ship Review; the objectives of this review are to confirm the (qualification) /

acceptance status of each satellite (NOAA-N and N') and to authorize its shipment to the launch pad or its storage;

- In-orbit Commissioning Review; the objective of this review is to confirm the inorbit status of the spacecraft and its instruments.

d) **METOP-1 and 2 reviews**

Following in text in italics to be updated by ESA (J. Bosma)

- ***System Requirement Review (SRR); the objective of this review is to assess the system level specifications and the phase CAD project development plans;***

- ***Preliminary Design Review (PDR); the objectives of this review arc to confirm the satellite design and to authorize the manufacturing of the Engineering Model;***

- ***Critical Design Review (CDR); the objectives of this review arc to confirm the detailed design and the performances of the satellite as demonstrated by the EM testing and to authorize the manufacturing of the Flight Model;***
- ***Qualification Results Reviews (QRR); for those satellite elements to which it is applicable, the objective of this review is to confirm their qualification status as obtained at the cad of the qualification process;***

- ***Flight Acceptance Review (FAR); the objectives of this review are to confirm the (qualification / acceptance status of each satellite (METOP-I and METOP-2) and to authorize its shipment to the launch pad or its storage;***

- ***In-orbit Commissioning Review; the objectives of this review are to confirm the inorbit status of the spacecraft and its instruments***

e) Ground Segment Reviews

The NOAA and EUMETSAT Ground Segment developments will encompass several distinct efforts: CDA upgrade/PCDA development, communication and operations facilities and software upgrades and developments, ingestion software, pre-processing software, product processing software, archiving software. When significant reviews take place, the other Party will be invited.

7.4 Product Assurance

Each Party will conduct and impose on its contractors its product assurance standards and procedures. In the frame of this cooperation, the product assurance standards and

procedures from each Party (including approved processes and part lists) ***are believed to be equivalent and suitable to the other Party - TBC***

7.5 Meetings

Coordination meetings

Coordination meetings, alternately chaired by the respective Programme / Projects Managers supported by appropriate representatives from EUMETSAT and NOAA shall be held, nominally, every six months or more frequently if required.

These meetings shall review the progress made by each Party in the implementation of the Agreement, identify, discuss and decide on programmatic and technical issues that may arise.

Technical meetings

Joint technical meetings shall be organized on an ad-hoe basis and as mutually agreed, to identify discuss and solve technical issues. In particular, these meetings will deal with the interface between the various LIPS elements. These meetings will include technical personnel from the Organisations and Industry as required. In addition, the Parties will invite each others to meetings, including those with third parties, which have a bearing on the fulfillment of that party's responsibility within their respective programmes.

Call-up for support

Call-up for support shall be initiated between specified officers of the Parties or their collaborating organizations as identified in the exchange of letters referred to in paragraph 7.2.3.

Others

It is expected that face-to-face meetings will be supplemented by telephone calls/ teleconferences and by exchange of correspondence, faxes and e-mail, as appropriate.

[NM] 7.6 Personnel / Contractor Visitation **Policy**

NOAA and EUMETSAT may dispatch appropriate personnel and / or personnel of their contractors, subcontractors, and / or collaborating organisations to facilities of the other Party, when necessary to implement responsibilities under this PIP.

NOAA and EUMETSAT may request that the other Party dispatch appropriate personnel

and / or personnel of their contractors, subcontractors, and / or collaborating organisations to participate in coordination meetings and related meetings with the agreement of the other Party.

The personnel of the visiting Party or the personnel of its contractors, subcontractors, and / or collaborating organisations shall comply with the internal rules of the corresponding facilities and with each Party's regulations and procedures.

7.7 Reporting and Schedule

NOAA and EUMETSAT shall each draw up a quarterly report on the schedule and execution of its tasks and communicate it to the other Party; issues will be phased to support the preparation of the coordination meetings identified in section 7.5.

7.8 Configuration Control

[NM] 7.8.1 General ***[moved the following section from specifically under Space Segment to General]***

For matters relating to the coherence of the IJPS and, in particular, the interfaces, a joint configuration management / control scheme will be implemented as follows:

- **The Parties will define and maintain a set of documents which will fully document the agreed technical baseline against which the interfaces of the various IJPS elements and the common elements of the IJPS will be developed. This set of documents will be identified in a jointly agreed Configuration Status List (CSL). It is expected that the CSL will be initially derived from the list of Joint Baseline Documents identified in Annex 1.**

- **Changes proposed by the Contractors or the Customers on the U.S. or the European side will be classified and disposed according to the respective procedures of each Party.**

- **The criteria to forward a proposed change to a Joint Configuration Control Board (JCCB) shall be those changes which would be reflected in any of the documents identified in the Configuration Status List. Implementation of any such changes shall be deferred until after the disposition of the JCCB.**

- **The JCCB shall comprise the Programme / Project Managers (or their duly appointed representatives) from NOAA, EUMETSAT, NASA and ESA, supported by their Configuration Management Officers (CMO) and cognizant engineers.**

- **The Programme / Project Manager of the organisation originating a change shall be responsible for forwarding the change to the JCCB, together with a justification of the change, a detailed description of the change and its implications, and along with the proposed amendments to the relevant documents. They shall be sent in parallel to the other three participating organisations.**

- **Answers to a proposed change (agreements / disagreements) and any evolution in the status of a proposed change shall be transmitted in an expeditious manner by telefax / e-mail. Disagreements will be discussed / resolved in bilateral or multilateral contacts, as appropriate (e.g. by teleconference). A *telefax agreement to a proposed change signed by the Programme / Project Manager or his duly appointed representative shall constitute formal approval to implement the change.***

  Above text in italics still TBC!

- **JCCB decisions shall be unanimous. A JCCB decision shall bear the commitment from all Parties to readily and immediately implement the agreed disposition. The CMO's from each organisation shall be responsible to control,**

  and report on, the subsequent documentation of the approved changes and to update accordingly the Configuration Status List.

- **The Parties will also establish and maintain a further set of documents which will fully document the technical baseline against which the IJPS elements will be developed. This set of documents will be identified in a jointly agreed Reference Document List (RDL). It is expected that the RDL will be initially derived from the list of Reference Documents identified in Annex 2. *[Address requirement for provision of updates to any of the Reference Documents to the other Party]***

- **Each Programme / Project Manager (NOAA, EUMETSAT, NASA, ESA) shall be responsible to transmit (for information), without delay, to the others any proposed change, which would be reflected in any of the documents identified in the RDL. The responsible Party shall ensure that consultation takes place for major changes e.g. affecting the performance or the use of instrument data.**

- **Each organisation: NOAA, EUMETSAT, NASA or ESA shall have the right to raise any issue for consideration by the JCCB.**

- **The CMO's will contact each others on a regular basis to exchange the status of the various JCCB changes within their organisation.**

- **Each organisation shall be responsible for identifying the relevant points of contact for all communication regarding any proposed changes.**

- **Each Party shall bear its own cost in implementing JCCB decisions.**

- **Any dispute that cannot be resolved by the JCCB shall follow the settlement of dispute procedures as stipulated in the Agreement.**

[NM] 7.8.2 Space Segment

NOAA with NASA and EUMETSAT with ESA, will implement configuration management / control procedures, through which proposed changes to the design or the implementation of the IJPS space segment elements it is responsible for can be thoroughly assessed, disposed, documented and controlled.

[NM] 7.8.3 Ground Segment

NOAA and EUMETSAT with the SAFs, will implement configuration management / control procedures, through which proposed changes to the design or the implementation of the IJPS ground segment elements it is responsible for can be thoroughly assessed, disposed, documented and controlled.

7.9 Logistics

Transport

The cost of transporting equipment required for the execution of this Agreement from one Party to a first destination of the other Party shall be borne by the Party dispatching the equipment. The receiving Party shall be responsible for any subsequent transport or return of the equipment to the Party of original dispatch.

Telecommunications

Costs for telecommunications and related services provided by third parties for the exchange of data and relay of commands if required shall be borne by the Party receiving the data unless otherwise agreed.

Taxes and Customs

Each Party shall facilitate customs clearance and freedom from import and export dudes, taxes or similar charges for System-related equipment moving between countries

concerned. Further, each Party shall facilitate the issuance of any necessary visas and permits to staff engaged in the activities related to the Agreement.

Additional NOAA General Comments:

1. Signature/approval of the PIP is contingent upon receipt of the complete set of JBD and RDs listed in Annex 1 and 2.

2. Need to add a Glossary or Definition section.

3. Need to clearly define AOn-Orbit Commissioning@ pHase of METOP satellites..

4. Need to confirm that processing software at EUMETSAT SAFs would be available for NOAA review.

5. Need to define when this PIP takes affect reporting, review support etc) and the frequency of review.

6. Need to add an Integrated Master Schedule of the IJPS into the JBD.

7. Need to add EUMETSAT and NOAA Organization charts and POC lists to RDs.

8. Need to add the data handling formats document to the RD (Command and Telemetry)

9. Need to add recorded data formats to the RD.

10. Investigate with EUMETSAT the possibility of establshing and on-line library for the JBD and RD documents and documentation of the application software.

11. Consider adding the Data Denial MOU as an Annex or in the JBD/RD lists.